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ABSTRACT

The dependence of reading on speech is based on three assumptions: speech is the primary language system, acquired naturally without direct instruction; alphabetic writing systems are more or less phonetic representations of oral language; and speech appears to be an essential foundation for the acquisition of reading ability. By presupposing those linguistic factors in reading processes, research was conducted on linguistic awareness of phoneme segmentation, phonetic coding in short term memory, and the phonetic pattern of reading errors. Based on that research, suggested basic procedures for initial reading instruction include coordinated activities in reading, phonics, spelling, and handwriting and a sequence of instruction that starts with letter names and sounds, then helps the child convert words from speech to print, and finally helps the child convert words from print to speech. Discussion following presentation of the paper is included. (RL)

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Speech, the Alphabet, and Teaching to Read[1]

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INTRODUCTION

In the research we have done on reading acquisition, we have been governed by the assumption that reading is somehow parasitic on speech (Liberman, 1971, 1973; Shankweiler & Liberman, 1972). We have been led to this assumption by certain observations that seem obvious. First, speech is unquestionably the primary language system, naturally and universally acquired without direct instruction. Reading, being secondarily derived from speech, is relatively unnatural, far from universally learned, and must be taught. Second, an alphabetic writing system is a more or less phonetic representation of the spoken language; it is not a separate symbol system which is keyed directly to meaning. And finally, speech appears to be an essential foundation for the acquisition of reading. Children who are blocked in the acquisition of speech, like the congenitally deaf, do not readily learn to read even though they have access to the printed word through the visual channel.

In an effort to explore the implications of the dependence of reading on speech, we have, in our studies of young children, investigated three related aspects of the problem: linguistic awareness of phoneme segmentation, phonetic coding in short term memory, and the phonetic pattern of reading errors.

In order to learn to read, the child must map the written word to the spoken word. It has seemed plain to us that to do this, he must have some recognition of the phonetic structure of his spoken language (Liberman, 1971). We know from speech research that phonetic structure is complexly encoded in the speech signal (A. M. Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). The consequence is that there

is no obvious acoustic criterion that marks the phonemic segments. We were thus led to ask whether the development of the awareness of these segments might be difficult for the child. Accordingly, we have investigated the child's development of phoneme segmentation ability and the relation of this ability to reading (Liberman, 1973; Liberman, Shankweiler, Fischer, & Carter, 1974).

The role of the phonetic representation in speech perception is to hold information about shorter segments (say, words) in short-term memory until the meaning of longer segments (say, sentences) can be extracted. That has led us to wonder if the phonetic representation derived from optical information might not serve the same purpose in reading. Therefore, we have investigated the use of phonetic coding in reading and, particularly, the differences in this ability between good and poor readers (I. Y. Liberman, Shankweiler, A. M. Liberman, Fowler, & Fischer, 1976; Shankweiler & Liberman, 1976).

Finally, guided by what we hope is common sense, we have supposed that by noting the particular errors that beginning readers make and analyzing them appropriately we might gain some insight into the processes underlying reading acquisition and at the same time test our hypotheses about linguistic factors in beginning reading (Fowler, Liberman, & Shankweiler, 1976).

In this paper we will review o[illegible]ndings in these three areas of investigation, emphasizing recent w[illegible], and will suggest some of the ways in which these findings can be applied in reading instruction. We will conclude with some observations about the possible contribution of the orthographic complexity of English to the problems of the beginning reader.

LINGUISTIC AWARENESS AND THE ALPHABET

In languages that are written alphabetically, the unit characters - letters - are keyed to the phonological structure of speech. We are aware that the mapping from written symbols to phonemes is more nearly one to one in other alphabetic languages, such as Finnish and Serbo-Croatian, than in English. The many departures from one-to-one mapping makes English difficult to spell and probably more difficult to learn to read than is the case in languages whose alphabetic writing systems have a simpler structure. We defer matters concerning the role of the orthography in the acquisition of reading until later sections of this paper. For the present it is sufficient to underscore the fact that English spelling, in common with other orthographies that employ an alphabet, is, for all its peculiarities, in essence a cipher on the phonemes of the language.

The child's fundamental task in learning to read is to construct a link between the arbitrary signs of print and speech. We have pointed out (Liberman et al., 1976) that there are different ways in which the child might do this. Words written by an alphabet can be read as though they were logograms, and many children undoubtedly begin reading in this way, apprehending the word shapes holistically, rather than analyzing them as letter strings. However, the reader who employs a nonanalytic strategy of this sort cannot benefit from a unique advantage of alphabetic writing. We refer to the fact that the alphabet enables its users to generate a word's pronunciation from its spelling. Thus a user can recognize in print a word he has never before seen written down, and

he can (at least to a rough approximation) pronounce a word which he has never before either heard or read. These powerful advantages are open only to a user who knows how the alphabet works, that is to say, one who can approach the reading task analytically.

Let us first outline briefly what is involved in reading analytically. First, the child must realize that speech can be segmented into phonemes and he must know how many phonemes the words in his vocabulary contain and the order in which they occur. Secondly, he must know that the letter symbols represent phonemes, not syllables or some other unit of speech.

In our earlier writings (Liberman, 1971; Shankweiler et al., 1972, 1976; Liberman et al., 1976) we have considered what it means for a child to know that speech can be segmented into phonemes. It does not mean simply that the child is able to discriminate word pairs that are minimally different. Every normal child of school age can do that. However, a child may be able perfectly well to discriminate between pairs of spoken words such as bet and best and to recognize each as a distinct word in his vocabulary without being aware that bet contains three phonemes and best contains four. Such a child, as we have said elsewhere, has only a tacit awareness of phoneme segmentation. This is sufficient, of course, for comprehension of the spoken message. Writing and reading, on the other hand, demand an additional capacity to analyze words as strings of phonemes. Mattingly (1972) and others have called this capacity "linguistic awareness."

We have suggested that an understanding of the acoustic structure of speech can help to explain why the ability to analyze syllables as strings

of phonemes is rather difficult to attain (Liberman, 1971). We suspect that in part the difficulty has to do with the fact that phonemes are not represented in the acoustic signal in discrete bundles, but rather are merged — "encoded" — into the structure of the syllable (as suggested by A. M. Liberman et al., 1967). The word dig, for example, has three phonetic segments but only one acoustic segment.

This merging of phonemes in the sound stream complicates the process of becoming actively aware of the phonemic level of speech for the would-be reader. We do not mean to imply that the young child has difficulty differentiating word pairs, such as bad and bat, that differ in only one phoneme. On the contrary, there is reason to believe that most children hear these differences as accurately as adults (Read, 1971). As we have said, the problem is not to teach the child to discriminate minimally different word pairs but rather to bring him to realize that each of these words contains three segments, and that they are alike in the first two and differ in the third.

Elsewhere (Liberman et al., 1976) we have dwelt on another important consequence of the encoded nature of phonemes that must contribute to the difficulty of learning to read analytically. Since the syllable, and not the phoneme, is the minimal unit of articulation, it is impossible to read by sounding out the letters one by one. On the contrary, it is necessary to discover how many of the letter segments must be taken simultaneously into account in order to arrive at the correct phonetic rendition of each syllable. Thus we have stressed that to read analytically is not to read letter by letter, even in languages in which the letter-to-sound mapping is more direct than in English.

We have argued that effective use of an alphabet requires a degree of active awareness of phonological structure that goes beyond the tacit level of comprehension adequate for speaking and listening. As we have seen, it is one thing to understand and to speak one's language and quite another thing to have analytic understanding of the language's internal structure. We have noted (Liberman, 1973) that the late appearance of the alphabet in the history of writing may be an indication that it is rather difficult to become aware of the phonological underpinnings of speech. If the obscurity of phoneme segmentation is a psychological fact about speech that indeed is related to the late appearance of alphabets on the world scene, then it is reasonable to suppose that the child might find phonemic segmentation difficult and there might be in the development of the child an order of difficulty of segmentation from word to syllable to phoneme that parallels the historical development of writing systems.

Development of the Awareness of Speech Segments in the Young Child

We tested the supposition directly in a recent experiment. The point was to determine how well children in nursery school, kindergarten, and first grade (4-, 5-, and 6-year-olds) can identify the number of phonetic segments in spoken utterances and how this compares with their ability to deal similarly with syllables (Liberman et al., 1974). The procedure was in the form of a game which required the child to indicate, by tapping a wooden dowel on the table, the number (from one to three) of the segments (phonemes in the case of one group, syllables in the other) in a list of test utterances.

At age four, none of the children could segment by phoneme, whereas nearly half could segment by syllable. Ability to carry out phoneme segmentation successfully did not appear until age five, and then it was demonstrated by less than a fifth of the children. In contrast, almost half of the children at that age could segment syllabically. Even at age six, only 70% succeeded in phoneme segmentation while 90% were successful in the syllable task.

Segmentation Ability and Reading Skill

The difficulty of phoneme segmentation has been remarked by a number of investigators besides ourselves (Calfee, Chapman, & Venezky, 1972; Elkonin, 1973; Gibson & Levin, 1975; Gleitman & Rozin, 1973; Rosner & Simon, 1971; Rozin & Gleitman, 1976; Savin, 1972). Their observations, like ours, also imply a connection between the awareness of phoneme segmentation and early reading acquisition.

We explored this question in a preliminary way by measuring the reading achievement of the children who had taken part in our experiment on phoneme segmentation the year before. Testing our first graders at the beginning of their second school year, we found that half the children in the lowest third of the class in reading achievement had failed the segmentation task the previous June; on the other hand, there were no failures in phoneme segmentation among children who scored in the top third of the class in reading ability (Liberman et al., 1976). Rosner (1975) has also found that the partial phoneme segmentation required by his elision task is also a significant predictor of reading achievement.

Three new studies by our research group now confirm these results. Despite widely varying school populations and diverse procedures, each of these studies shows a high and significant correlation between phoneme segmentation and early reading ability.

Helfgott (1976) recently completed a study of the segmentation and blending skills of kindergarten children in a white, middle-class suburban school in Connecticut. In connection with this study, she looked at the usefulness of several different skills as predictors of first grade reading achievement in the following year. Using an adaptation of the Elkonin procedure (1973) for the assessment of phoneme segmentation she found that the best predictor was the ability to segment spoken CVC words into their three constituent phonemes. The correlation of this ability with reading achievement on the word recognition subtest of the Wide Range Achievement Test (WRAT) (Jastak, Bijou, & Jastak, 1965) was substantial ($r = .75$).

In an investigation of the phonological awareness and reading acquisition of first graders in an integrated city school in Rhode Island, Zifcak (1976) demonstrated a highly significant relationship between ability to segment phonemes on the Liberman Tapping task (Liberman et al., 1974) and reading success as measured by the Gallistel-Ellis Test of Coding Skills (1974) as well as on the WRAT.

Treiman (1976) examined first and second graders in an inner city school in New Haven with a largely black population. She used a task requiring the placement of the correct number of tokens (rather than dowel tapping) to indicate the number of the constituent phonemes. Her stimuli

were not words, but two- and three-segment syllables in which the incidence of eight vowels, four stops, and four fricatives was carefully equated. She added the much needed control of ascertaining the counting ability of the subjects. In addition to the WRAT, she included an experimenter-devised reading test which allowed for a more analytic assessment of early reading skills. Once again, in spite of these many variations, the relationship between segmenting ability and reading success was highly significant.

These investigations of the relation between segmentation abilities and reading proficiency suggested that ability to analyze speech phonemically is indeed relevant to success or failure in learning to read. The results so far lend encouragement to our hypothesis that segmentation abilities are cognitive prerequisites for reading. We turn now to consider another aspect of language development that may bear on reading acquisition.

THE ROLE OF THE PHONETIC REPRESENTATION

At this point we should explain in general terms how we view the role of a phonetic representation. It is characteristic of the perception of language, as A. M. Liberman, Mattingly, and Turvey (1972) have noted, that the perceiver remembers the gist of what was said and not the exact sentences, word for word, that the speaker uttered. That is, the speaker's original message is recalled in the form of a paraphrase. However, the paraphrase depends on the operation of a highly temporary memory system which contains a literal record of a small portion of the message as the hearer receives it. When we perceive a stretch of running speech, we rely on a working memory span of a few words that are held in phonological form. This can be

demonstrated informally by abruptly interrupting a spoken communication. Typically the listener can, on demand, repeat word for word the last few words or the last sentence that was uttered. One of the aspects of this short-term memory representation, then, is that it retains the most recent portion of the utterance in exact phonological form.

In speech, the primary function of this literal, limited-capacity and highly temporary memory representation, is, in Liberman, Mattingly and Turvey's (1972) view, to permit comprehension of the message. In order to comprehend what was said, we need to hold information about shorter segments (in our example, words) in memory until the meaning of the longer segments (here, sentences) can be grasped. But does reading necessarily require the same kind of memory representation as speech? If reading is rightly conceived as an alternative means of perception of language, then we may expect it to share many processes in common with the perception of speech. Reading involves interpretation of symbols that stand as surrogates for speech segments. Thus, the reader's task, as we conceive it, is literally to convert print to speech, whether overtly, or (more usually in the case of the experienced reader) into some covert form. Although we do not rule out the possibility that read words can be held temporarily in some visual form, it seems reasonable to suppose that in reading, no less than in perception of speech by ear, the perceiver makes use of a phonetic representation in order to comprehend the message.

In the case of an alphabetic language, there is an additional reason for supposing that the reader derives a phonetic representation from print. The fundamental characteristic of alphabetic writing systems is that the

letter symbols are a cipher on the phonemes of the language. Thus a reader who uses the alphabet analytically (in the sense of our discussion on pp.4-6) necessarily derives a phonetic representation. It is certainly the case that any reader must recode the written script phonetically if he is to decode a new word that he has never seen before. But does he need to recode phonetically words and phrases that he has read many times? Does he in these cases continue to construct a phonetic representation, or does he, as some believe, by-pass the phonetic level and go directly from visual shape to meaning?

It seems plausible to us that phonetic recoding might occur even with frequently read materials and may persist in experienced, skilled readers precisely, as we have intimated above, because a phonetic representation plays a functional role in comprehension. Elsewhere (Liberman et al., 1976; Shankweiler et al., 1976) we have speculated that the perceiver needs a phonetic base in order to index the mental lexicon and to reconstruct those prosodic cues so essential to comprehension of spoken language that are not directly represented in print.

Apart from our speculations on the role of a phonetic representation in reading, there is much experimental evidence that phonetic recoding does typically occur in a variety of situations in which the perceiver is confronted with visually presented linguistic material which he has later to recall. Most of the relevant experiments take the following form: lists of letters or alphabetically written words are presented to be read and remembered. Confusions in short-term memory are based not on visual similarity, but on phonetic similarity to the presented material. Conrad

(1972) has noted that even nonlinguistic stimuli may be recoded into phonetic form and stored in that form in short-term memory. It was found, in this connection, that in recall of pictures of common objects, the confusions of children aged 6 and over were clearly based on the phonetic forms of the names of the objects rather than on their visual or semantic characteristics.

All of these experiments are relevant to the assumption that even the skilled reader might recode phonetically in order to gain an advantage in short-term memory and to utilize the primary language processes he already has available to him.

In saying this, we do not imply that the only way to obtain meaning from script is via the intermediary of a phonetic representation. Our intent, rather, is to question the assumption (cf. Bever & Bower, 1966) that a direct mapping strategy that bypasses the phonetic level would always be the preferred mode of the mature reader. Such an assumption is unwarranted in our view because it overlooks the large bulk of evidence that suggests that the organization of short-term memory is inherently phonetic.

Phonetic coding in good and poor readers

As we have seen earlier, a significant characteristic of the poor reader is his difficulty in identifying the phoneme, the unit most directly represented by the alphabet. In view of the short-term memory requirements of the reading task and evidence for the involvement of phonetic coding in short-term memory, we might expect to find that those beginning readers who are progressing well and those who are doing poorly might be further distinguished by the degree to which they rely on phonetic coding.

To explore the hypothesis that good and poor readers differ in the degree to which they use phonetic coding in short-term memory, we have carried out three sets of experiments with second graders.

In two of the experiments we used a procedure similar to one devised by Conrad (1972) for adult subjects in which the subject's performance is compared on recall of phonetically confusable (rhyming) and nonconfusable (nonrhyming) letters. In the first of these experiments (Liberman et al., 1976) the stimuli were strings of five uppercase consonants, half rhyming (drawn from the set BCDGPTVZ) and half nonrhyming (drawn from the set (HKLQRSWY), presented tachistoscopically in a 3-sec exposure. Recall was tested under two conditions — immediately after presentation and after a 15-sec delay. In the second experiment (Shankweiler et al., 1976) the same procedure was followed except that the letters were presented auditorily on tape. Since auditory presentation requires successive input, a parallel condition using visual serial presentation was added in this experiment.

No matter whether the presentation was visual or auditory, simultaneous or successive, the results were virtually identical. Though the superior readers were better at recall on the nonconfusable items than were the poor readers, their advantage was virtually eliminated when the stimulus items were phonetically confusable. Though the effect was particularly marked in the delay condition, phonetic similarity always produced a greater penalizing impact on the superior readers than on the poor ones. And it made practically no difference whether the items to be recalled were presented to the eye or to the ear.

These first two experiments strongly suggested that the difference between good and poor readers in phonetic coding will turn on their ability to use a phonetic representation, whatever the source, and not merely on their ability to recode from script. However, two major criticisms might be levelled at both experiments. First, since the stimuli used were strings of unrelated consonants, the generalizability of the results to more realistic reading situations could be in question. Second, since the procedures did not control for the effects of rehearsal, the differences between the two reading groups might be accounted for by different rehearsal strategies.

A third experiment, using an adaptation of the Hyde and Jenkins memory paradigm (Hyde & Jenkins, 1969), addressed itself to both criticisms (Mark, 1976). The subjects were given a list of 28 words to read aloud, followed by a second or recognition list containing all the original words and, in addition, 28 new words or foils. Half the foils were phonetically confusable with (but visually dissimilar from) a given word on the original list. The remaining 14 foils had no rhyming counterpart on the list. The subjects were required simply to respond yes or no as to whether a given word on the recognition list had appeared on the original list. Once again, though the stimuli were words, not strings of letters, and though rehearsal could not have been involved, the good readers were much more strongly penalized by the confusable items than the poor readers.

We regard these as interesting results. It is a relatively easy matter to demonstrate that good readers do better than poor readers on a

variety of language-dependent tasks. In these three experiments, however, we have been able to show that it is possible to penalize good readers by making it disadvantageous for them to use a phonetic coding strategy. Therefore, it now seems reasonable to conclude with some confidence that good readers are more likely than poor readers to use a phonetic coding strategy effectively.

THE ANALYSIS OF READING ERRORS

One aim of our early research efforts (Shankweiler et al., 1972) was to determine whether the errors made by beginning readers when they attempt to read words and syllables pattern consistently and if so, whether an analysis of their pattern of errors might provide insights into the problems of reading acquisition. Accordingly, we carried out a phonetic analysis of reading errors in a number of experiments with beginning and disabled readers. A consistent pattern emerged from this analysis: errors on the final consonant of a CVC syllable were roughly double those on the initial consonant, while errors on the medial vowel exceeded those on consonants in both initial and final position. It seemed apparent from these experiments that the error frequency varied systematically with the position of the target phoneme in the syllable.

We considered that this distribution of errors in the syllable could be interpreted as reflecting the child's lack of understanding of the phonological segmentation of his spoken language. If a child had not yet developed an ability to analyze the phonetic structure of his speech, he might be expected to show just this pattern of error — success with the initial segment, which can be extracted without further analysis of

the internal structure of the syllable, and comparatively poor performance beyond that point. Such a child, who knew some letter-to-sound correspondences and that he must scan in a left-to-right direction, might simply be searching his lexicon for a word, any word, beginning with a phoneme that matches the initial letter. By this reasoning, if he were presented with the word big, he might, in context, give a response like beautiful, or out of context, butterfly. Neither response could occur if he were searching his lexicon, as he should, for a word that has three phoneme segments corresponding to the letter segments in the printed word. If, however, he is unaware that words in his lexicon have a phonetic structure, or if he has difficulty in determining what that structure is, his errors would increase after the initial segment. As to the relatively high incidence of his errors on vowels, it could, in these early experiments, have been simply attributed to the imbedded position of the letter representing the vowel in the CVC syllable of the stimulus list.

Though the pattern of consonant and vowel errors obtained in this early work was suggestive, certain controls were needed before we could accept its reliability. The purpose of a new series of experiments (Fowler, et al., 1976) was to confirm this pattern and, by the addition of various controls, to test its generality. Second, third, and fourth graders were the subjects in the new experiments. They were asked to read items from two lists of words,[2] one in which the incidence and location of the consonant phonemes were controlled, and the second in which these conditions were taken into account for the vowels.[3]

Differences in Consonant and Vowel Error Patterns

In this new set of more fully controlled experiments, we found the same pattern of consonant errors as previously obtained. Though the absolute number of errors decreased as the grade level of the child increased, the consonants in final position continued to produce approximately twice the number of errors as those in initial position. We were able to conclude that the consonant error pattern did indeed represent a true position effect and could, with some confidence, be attributed to the difficulties of phonological segmentation.

In contrast to the findings on consonant misreadings, errors on vowels showed no effect of position. When the vowels were placed in initial, medial, and final position, the errors did not vary systematically in frequency according to their location. Moreover, vowels continued to elicit a greater number of errors regardless of their location in the syllable. Thus, the high vowel error rate in the earlier experiment, could no longer be explained by the medial position of the vowel and could not be related primarily to the difficulties of phonological segmentation.

The possibility that consonant and vowel errors might have different causes was supported by the results of a further analysis that took account not of the location of the errors in the syllable, but of the phonetic nature of the substitutions. In that analysis, it was found that consonant errors were systematically related to the target phoneme in the word, differing from it most often in only one of the three distinctive features of consonants (voicing, place of articulation, and

manner of articulation). The proportion of consonant errors sharing two features with the target phoneme was remarkably stable across the grades: 60 percent of second-grade errors, 61 percent of third-grade errors, and 62 percent of fourth-grade errors. The results suggested, therefore, that phonetically motivated substitutions contribute substantially to the consonant error pattern both at the very early stages of reading acquisition and beyond. Vowel errors, in contrast, were not systematically related to the phonetic features of the presented vowel (tenseness, tongue advancement, tongue height, and diphthongization): indeed, the feature distribution of the vowel errors was essentially random at every grade level. Thus, the concept of featural similarity, so successful in rationalizing the substitutions among the consonants, does not enable us to understand the vowel errors.

The contrasting results obtained for consonants and vowels are indeed striking. The opposition of these phonetic classes was revealed, as we have seen, by both approaches to error analysis: the first, in which we investigated misreadings in relation to their location in the syllable, and the second, in which we considered the phonetic characteristics of the substitutions. As to the consonants, their position in the syllable accounted for the frequency of their occurrence while the phonetic features of the target phoneme largely determined the nature of the substitution. With the vowels, on the other hand, neither of these relationships obtained. Factors other than these must, therefore, be considered to account for the vowel error pattern. One factor that suggests itself immediately is the

variability of vowel orthography. Whereas the rules relating spelling to phonetic segment are relatively straightforward for consonants, they are quite complex for English vowels. Work in progress appears to single out the complexity of the orthography as a contributing factor in the vowel error pattern, though it was not so for the consonants.

The Error Pattern and Nonvisual Factors in Reading

These differences in error pattern lend credibility to the position taken by us and other investigators (Liberman, Shankweiler, Orlando, Harris & Bell-Berti, 1971; Vellutino, Pruzek, Steger, & Meshoulam, 1973; Vellutino, Steger, & Kandel, 1972) that visual perceptual factors are not sufficient to account for the difficulties of the beginning reader. It is hard to see how deficits in scanning, eye movements, and/or the discrimination of the optical form of letters can explain the differences we have found in consonant and vowel error patterns. Taken as optical shapes, the set of letters representing consonants is not marked in any distinctive way from the set representing vowels; the differences in error pattern between consonants and vowels, therefore, cannot be related to a classification based on visual characteristics.

Consonants and vowels do, in contrast, form distinctive categories in the language with different functional roles in communication that might well lead to correspondingly different error patterns. Considered from the standpoint of their contribution to the phonological message, consonants carry the heavier information load. (A demonstration of this fact can be easily made: one needs only to compare the information obtainable in a sentence from which all the vowels have been deleted with one in which the consonants have been similarly treated.) The vowels, on

the other hand, are the nucleus of the syllable structure and as such are the carriers of prosodic features. They are more subject than consonants to phonetic variation across individuals and dialect groups, and more subject to phonetic drift over time. As we suggested in an earlier paper (Shankweiler et al., 1972), the relatively greater variability of vowels than consonants may even account in part for the different ways these segments are represented in the orthography, particularly the larger variations in vowel spellings.

Additional evidence that language-related rather than visual factors may be critical in early reading acquisition comes from a series of studies we have begun with second grade good and poor readers. In this recent research, we are investigating coding in short-term memory, not the error pattern in reading, but the results of one of the experiments are nonetheless directly relevant here. The paradigm used was an adaptation of Kimura's test of memory for recurring figures (Kimura, 1963). In this test, a series of stimuli are presented consecutively and the subject simply has to report yes or no as to whether the stimulus has already been seen in the series. There are 4 recurring stimuli which are exposed once in each set of 10 cards, randomly interspersed with 6 nonrecurring stimuli. Eight sets (of 10 cards each) make up a total of 80 cards in the test. The first set of 10 cards constitutes the presentation trials; the following 7 sets are the recognition trials. This same procedure was carried out with three different sets of 80 stimuli — nonsense designs, photographed faces, and nonsense syllables. The results speak for themselves. The poor readers were slightly better than the good readers in memory for nonsense designs,

but not significantly so. There was also no difference between the two groups of readers in face recognition. The good readers were better than the poor readers only in the nonsense syllables test, and there the difference was highly significant. Thus, despite identical procedures, neither nonlinguistic visual task differentiated between the good and poor readers, while the language-based visual task did. We would reason that in the nonsense syllable task, though not in the others, the good reader had a clear advantage: he could recode the information phonetically and thus hold it more efficiently in short-term memory.

At all events, perhaps the most general implication of these findings and those we have obtained in the error analysis is that they again underscore the importance of nonvisual cognitive processes in reading and, specifically, those relating to language, such as awareness of phonological segmentation, phonetic recoding, and knowledge of the orthography.

IMPLICATIONS FOR INSTRUCTION

It has become fashionable to say that very little is known about how to teach reading and that the teacher makes a greater difference than the method. We would agree that the teacher's flexibility and wisdom in adapting existing curricula to meet individual differences, as well as his ability to recognize the necessity for doing so, will always be important variables in the success of any instruction procedure. However, we would also maintain that the little we do know about reading is often not reflected in reading curricula. If it were, even the less creative teacher might be more successful and the proportion of children resistant to reading instruction might be decreased.

To take a very basic example, consider what we know about our writing system—namely, that it is alphabetic and not ideographic. From this, it would seem to follow that instructional procedures should inform the child early on that the printed word is a model of the component phonemes and their particular succession in the spoken word. Conversely, it would follow that the instruction should not, as it often does, mislead the child into assuming that the printed word is an ideographic symbol, a notion that will have to be corrected later, and, apparently for some children, with great difficulty. Procedures which initiate the child into the mystique of reading by drawing his attention to the visual configuration ("remember this shape; it has a tail") and its associated meaning ("the one with the tail means monkey") without alerting him to the relevance of the sound structure of the word may lead the child into a blind alley. His ability to memorize the shapes and associated meanings of a handful of words may lull him and his parents into the comforting belief that he can read, but may leave him stranded at that stage, a functional illiterate with no keys to unlock new words.

Teaching a child how to use an alphabetic system to fullest advantage is complicated by the difficulty young children have in explicitly understanding the phonemic structure of their speech. As we have said, phonemic analysis is hard because of the encodedness of spoken speech into units of syllabic size; syllabic segmentation is demonstrably much easier. However, it need not follow that the phonemic level of analysis should be by-passed at the beginning in favor of the syllable or the word. Instead, perhaps the child can be given a better preparation for phoneme segmentation before reading instruction begins. With that preparation, certain elements of both the so-called phonic and syllabic methods can be introduced later to good effect.

How to Prepare the Child for Phonemic Analysis

The groundwork for this difficult level of analysis begins at home before the child is old enough to go to school. A proper foundation laid at this point can continue to be built upon in the pre-reading stages of kindergarten and at each succeeding stage of reading acquisition.

Word-play in early childhood. Games in early childhood that draw the child's attention to the phonemic content of his spoken language and that give him extended practice in "playing" with words may provide a foundation for future segmentation ability. Examples of such word play would include the learning of nursery rhymes and the introduction of rhyming games that use both real words and nonsense syllables. The value of rhyming activity is that it varies the phonemic content while making few semantic or syntactic demands on the child.

Pre-reading techniques. When the child reaches kindergarten, pre-reading techniques would stress the phonemic structure of the spoken word before the written letters are introduced. "Listening games" that require the child to identify the initial, medial, and final phonemes in spoken words are in common use and need not be described here. Our only complaint with them is that they are not emphasized sufficiently in pre-reading training, and that, in actual practice, they often stop with the initial consonant. Teacher-devised methods that might help the child to hear sounds in words are limited only by the creativity of the teacher. One teacher (Marian Howard, personal communication, 1974) reports that she began pre-reading instruction for her kindergarteners at the Horace Mann

School in New York by first teaching them to listen for the five short vowel sounds in words. Among the games she describes is one which seems particularly useful. In the first stage of the game, the teacher says a given vowel sound ("ă") once, twice ("ă ă"), or three times ("ă ă ă") and asks the class in each case to raise as many fingers as sounds they have heard. After the children can do this correctly with all the short vowel sounds, she adds a consonant to the vowel, thus producing VC syllables ("am," "it," "op," etc.). She intersperses these syllables with single phonemes of the previous lesson and again asks for finger raising. She then progresses to CV syllables, thence to CVC, CCVC, etc., varying vowels and consonants at each stage as needed. She reports that after instituting this "auditory program" in the fall, she could begin teaching reading by Christmas, and 90% of her kindergarteners were decoding print by April (the date of her report to us).

Several auditory training programs which emphasize the analysis of syllables into phonemes (rather than the discrimination of non-speech sounds) have been available commercially for some time (see, for example, Lindamood & Lindamood, Auditory Discrimination in Depth, 1969), but none, to our knowledge has as many worthwhile features as that outlined by the Soviet psychologist, Elkonin (1973).

In the procedure described by Elkonin, the child is presented with a line drawing of an object, animal, etc., the name of which is in his active vocabulary. Below the picture is a rectangle divided into sections equivalent to the number of phonemes in the pictured word. The child is taught to say the word slowly, putting a

counter into the appropriate section of the diagram as he pronounces the word. After this "game" has been played with many different pictured words and the child can do the task successfully without the diagram, the idea of vowel and consonant sounds is introduced. At this time, the color of the counter is differentiated for the two phonetic classes—say, pink for the vowels, white for consonants. The child is first taught the difference between them with one vowel sound, being asked to put down a pink counter whenever he hears that sound. Not until the child can do this with the five short vowel sounds is the graphic form corresponding to the sound introduced.

The Soviet procedure has many pedagogical virtues. First, the line drawing keeps the whole word in front of the child throughout the process of analysis so that he does not have to rely on auditory memory to retain the word being studied. Second, the diagram provides the child with a linear visual-spatial structure to which he can relate the auditory-temporal sequence of the spoken word, thus reinforcing the key idea of the successive segmentation of the phonemic components of the word. Third, the sections of the diagram call the child's attention to the actual number of segments in the word, so that he does not resort to uninformed guessing. Fourth, the combination of drawing, diagram, and counters provide concrete materials which help to objectify the abstract ideas being represented. Fifth, the procedure affords the child an active part to play throughout. Finally, the color coding of the counters leads the child to appreciate the difference between vowels and consonants early in his schooling.

The actual content of the Elkonin procedure can, of course, be varied to fit the needs of the particular child or group of children, thus permitting its use not only for kindergarteners but also as a remedial technique for older children as well. The teacher can, for example, select for analysis syllables that contain whatever phonemes in whatever sequence she deems appropriate.

Three general rules might be suggested for the selection of syllables to be segmented. First, for this early training period, the noise portion of a fricative like /s/ or the nasal murmur of /n/ or /m/ would be the consonants of choice for the prevocalic position in the syllables to be analyzed. These have the advantage that, unlike other consonants (particularly the stops), they can be produced in isolation. They can thus be used to acquaint the child with the general idea of word analysis without undue interference from coarticulation. Second, since two-segment analysis is easier than three-segment (Helfgott, 1976), training in segmentation might start with two-phoneme syllables. Finally, pilot data (Treiman, 1976) suggest that VC syllables are easier to analyze then CV and that both are (as we have said) easier than CVC syllables. Therefore, a VC to CV to CVC succession in segmentation training would probably be most efficacious.

Another approach to training in phonological analysis, the elision technique outlined by Rosner (1975) in his "auditory skills program," places a somewhat greater conceptual burden on the child, but could profitably be used in conjunction with the Soviet procedure. It is always useful to offer a variety of different methods for attaining the

same goals— with the proviso that the emphasis in the auditory training should be on the analysis of the sounds of speech. Training in non-speech sounds, which are processed quite differently, cannot be expected to have the same effect (Liberman, 1971).

Once the child has been taught, by whatever method, to segment spoken syllables into their phonemic components, the graphic representations of the phonemes can be introduced. The Elkonin technique of adding the letter form to the blank counters might be adopted for teaching the graphic representation of the short vowels and one or two consonants. Thereafter, it would probably be preferable to shift to a more direct procedure for teaching the letters and their phonemic equivalents. This is the stage at which the child progresses from the pre-reading phase to reading instruction proper.

Basic Procedures for Initial Reading Instruction

We believe that the primary emphasis in teaching to read in an alphabetic system should be on mapping the components of the printed word to those of the spoken word. This analytic conversion from print to speech is best accomplished, in our view, by a method which presents reading, phonics, spelling, and handwriting in coordination with each other so that the instruction in each of these skills reinforces and illuminates the others. The integration of these four aspects of alphabetic communication serves to inform the child that they are indeed different facets of the same process and not separate, unrelated skills.

The first step: letter names and sounds. We would begin reading instruction, as many so-called phonics programs do, by teaching the child to associate the shape of the letter with its name and the sound it makes. We have come to agree with Mathews (1966) in his appraisal of this crucial first step: "... no matter how a child is taught to read, he comes sooner or later to the strait gate and the narrow way: he has to learn letters and the sounds for which they stand. There is no evidence whatever that he will ultimately do this better from at first not doing it at all."

The simplest and most efficient way of teaching the sound-symbol correspondences is by the direct teaching of paired associates. The child should not be expected to abstract the correspondences for himself by a discovery method. Though some can do so, too many will fail. Useful materials for teaching the alphabet are alphabet cards which include not only the upper and lower case form of the letter but also the mnemonic of a pictured key word beginning with the sound of the letter (Slingerland, 1971). On presentation of the card, the child is trained to recite the name of the letter, its keyword, and its sound (ā, apple, ă). As the child learns each vowel, its symbol should be listed in a vertical column on the blackboard and reviewed each day. After the child has learned the five short vowels in this way, a few consonant symbols are introduced. Teaching of the remaining consonants by the same procedure can be continued in tandem with the next step. Meanwhile, the child is taught to write these same letters that he has learned to identify, not an unrelated series of letters presented in a separate "writing lesson."

Conversion from speech to print. The next step in most reading programs which emphasize phonics would probably be "blending". Since letter-to-sound correspondences have been learned in isolation, the traditional phonics method requires that these be combined or blended to form words. There the method runs afoul of the fact about speech that we have emphasized earlier: the spoken word is not a merging of a string of consecutive sounds. In speech, information about the three segments of the word "cat" is encoded into a single sound, the syllable. Therefore, no matter how fast the consecutive phonemes are spoken, "kuh- a- tuh" merged together consecutively will produce only the nonsense trisyllable "kŭhatuh" and not the monosyllabic word "cat" (see A. M. Liberman et al., 1967 and Liberman, 1971 for extended discussions of this point).

How can we get around the problem of the fusion of phonemes by coarticulation? Though she also uses the more traditional blending method, Slingerland (1971) describes another technique which solves this fairly well. In effect, it is a spelling procedure that goes from speech to print and builds on skills which have been learned in the pre-reading program. Instead of demanding of the child the impossible task of blending "huh-ă-mm" to produce "hăm", the teacher first says the word, "ham" slowly, emphasizing the medial vowel. The child repeats the word, listens for the vowel sound, selects its letter card (color-coded as a vowel) from a wall pocket chart and places it in a lower tier of the pocket chart. The teacher then repeats the whole word and asks the child for the initial sound in the word. He selects

the appropriate letter card, identifies it, and places it, at the teacher's direction, in front of the vowel ("Where does it go? Before the a, because it's the first sound we hear"). The teacher then draws his finger along the two letters which the child has placed in the lower tier and says: "Now we have made 'ha'. Let's listen to our word again. Our word is 'ham' (drawing out the sounds). What is the last sound we hear in 'ham'? That's right, it's 'mm'. Find the letter that makes the 'mm' sound. Where do we put the m? At the end of the word, because it's the last sound we hear." The lesson continues with the child reading aloud the whole word which he has just constructed and ends with the child writing the word either on the blackboard or at his desk and reading it back after he has written it.

This procedure makes concrete for the child a key fact about writing that is difficult to explain in the abstract, namely, that temporal succession of the overlapping and nondiscrete speech segments (the phonemes) is represented spatially by a left-to-right linear succession of discrete characters (the letters).

A question that arises about this particular lesson is whether it might not confuse a child who has sequencing problems, since it requires him to start word analysis with the medial vowel sound and then to shift forward to the initial consonant sound. The answer is that, in actual practice, it does not seem to cause confusion. Typically, most children have sequencing problems in early reading acquisition only because they do not understand about the sound structure of the word and its relation to the written word. This spelling procedure has been preceded by much

practice in listening for the components of spoken syllables. By building upon a foundation of knowledge of the sound structure of the word, the spelling procedure simply clarifies the relationship of the spoken word to print.

Thus far, then, the child has learned the letters and their sounds in isolation and has been taught, without using questionable blending methods, how to convert speech to sequences of letters, that is, how to analyze the spoken word and to construct its written model. But he still needs to be taught how to go from print to speech.

Conversion from print to speech. The next step is probably the most critical one since it should prepare the child to make the conversion from any printed word to speech, which is what early reading acquisition is all about. We are indebted to two teachers, Nancy Chapel and Cynthia Conway, learning disability specialists in the Greenwich, Connecticut public schools, for a sequence of lessons which has been highly successful at this stage of reading training (personal communication). Their procedures can be best characterized as a modification of the "linguistic" method of minimal contrasts, in which the unit under study is the syllable. The goal of their procedures is to make the conversion from printed syllables to speech more nearly automatic by circumventing the letter-by-letter sounding out and blending of the phonics method. The difference between their procedures and other syllabic methods is in the added structure built into the procedure which elucidates the internal construction of the syllable for the child.

In the Chapel-Conway lessons, the short vowels are listed on the blackboard in a vertical column and reviewed, just as they had been during the alphabet drills. At this time, however, a dash is added after each letter (a_, e_, i_, o_, u_). The child is taught that the short vowel is always followed by a consonant and that the dash represents a missing consonant which will be filled in later. He is then taught the game of adding a letter in front of the short vowel and pronouncing the resultant combination (mă_, mĕ_, mĭ_, mŏ_, mŭ_). The prevocalic consonant is then varied (să_, sĕ_, sĭ_, sŏ_, sŭ_, etc.). Meanwhile, the children are encouraged to think of words beginning with those syllables and are taught to fill in the missing final consonants in those words (man, met, mop, etc.). The lessons continue with the addition of consonant blends to the front of the vowel (smă_, smĕ_, smĭ_, etc.).

When the short-vowel, closed syllable has been mastered, the idea of the long vowel is introduced, again with a structured model (a-e). It is pointed out that the missing letter in the model is now followed by an e, which is silent but marks the long vowel. Games of word construction with this model are then added. In the last stage, the child learns that when these consonant-vowel combinations appear alone without the added consonant (the dash representing the missing letter is now erased), the vowel is long and matches the letter name.

The child now has at his command a number of the major elements needed for decoding phonetically regular words. He can read closed syllables much more readily than he would if he had to depend on three-step (C-V-C) analysis and blending. At worst, since he knows CV syllables,

he will have to resort only to a two-step blending (CV-C) which has been found to be easier (Helfgott, 1976). The basic contrast between the short and long vowels has been clarified, as well as that between closed and open syllables. Both of these understandings will be of importance to the child in learning to read polysyllabic words and words with more complex vowel orthography.

In conclusion, we must emphasize that we do not pretend to have developed a reading curriculum. What we have offered here are simply the outlines of a few basic procedures for initial reading instruction that seem to follow logically from what is known about the reading process and that have proved successful in informal tests by teachers in the field. We would expect that the use of these and other procedures that relate print to speech will work more rapidly to achieve "reading for meaning," with fewer casualties, than could be accomplished by a program that stresses meaning at the outset.

A POSTSCRIPT ON THE CONTRIBUTION OF ORTHOGRAPHY TO READING PROBLEMS

As we have noted earlier, one source of difficulty in reading English is the nature of the orthography and the complex ways in which it represents the language. It is clear, however, that the complexities of the English orthography cannot be the sole explanation of reading difficulties, since some children continue to have problems even when the spelling of the words used in their instruction is phonetically regular and maps the sound directly (Savin, 1972). Nonetheless, we think it useful to look at early reading acquisition in an alphabetic writing system where the complications of orthography are minimized. Serbo-Croatian, the chief

language of Yugoslavia, is such a case. The Serbo-Croatian writing system was devised on the principle of one letter shape for each phonemic unit in the language ("Write as you speak and read as it is written!" was the working motto of F. S. Karacic who introduced the new orthography).

However, before we can consider the consequences of the regularity of Serbo-Croatian orthography, we must take note of another characteristic of that writing system, namely that, for reasons of politics and religion, two alphabets—one Cyrillic and the other Roman— were developed. Though they both represent the language quite directly, these two alphabets bear a complex relation to each other.[4] While some letters in the two alphabets share both the same shape and the same phonetic value, others are the same in shape but have different phonetic values. In still other instances, different letter shapes are used to represent the same phonetic units. Despite all these possibilities for confusion and interference, one of us was assured in a recent visit to Belgrade schools[5] that the double alphabet presents no problem: all the children learn the forms and letter-to-sound correspondences of both alphabets by the end of the second grade. The children are taught one alphabet for the first year and a half and then master the other by the end of the second year. This should certainly give pause to those who would espouse visual-perceptual and simple memory deficits as causal factors in early reading disability—that is, if their faith had not already been somewhat shaken by the ability of Japanese first graders (and recently even kindergarteners) to learn the shapes and sound correspondences of two different sets of some 49 kana symbols (Makita, 1968).

As to the consequences for reading acquisition of the simple orthography of the Serbo-Croatian writing system, that is harder to evaluate. In the first place, children in Yugoslavia enter school at age seven, thus affording them an extra year of development before they must face the reading task. Secondly, no data are available on the actual incidence of reading disability.

It would appear, however, that some children do have reading problems, because the schools have developed extensive programs of prevention and remediation. One school we visited in Belgrade, for example, had a thorough pre-school screening procedure. In the spring before school entrance, all the children are individually examined for intelligence, handedness, speech and motor development, socio-cultural background, and emotional adjustment. Those with special problems are identified and given additional diagnostic testing and assistance as needed. Another facet of the built-in preventive program in the primary grades of this school is team teaching. Teachers of each grade exchange classes at frequent intervals throughout the school year and hold regular consultations with each other on how best to teach all their problem children; if they decide that additional special remediation in reading is indicated, they refer the children to therapists who advise the teachers and work directly with the children.

It is interesting to note that the basic training of these therapists is in phonetics and speech pathology. We should suppose that the educators require that background in their therapists because they assume a close relation between speech and reading. In any event, the therapy certainly

reflects that particular bias, just as ours does. For example, heavy emphasis is placed in both developmental and remedial instruction on pre-reading drill and exercises in the analysis of the spoken word. Moreover, once the alphabetic letters are introduced, the procedures are again quite similar in general approach to those we have outlined here. That is, the instruction is directed toward clarifying for the child the relationship between the spoken word and its written counterpart.

The importance that Yugoslavian instructors attach to relating print and speech was made clear to us by Professor Spasenja Vladisavljević of the Institute for Experimental Phonetics and Speech Pathology at Belgrade University, who is in charge of the training and supervision of the therapists. She illustrated her point by describing a typical first-grade reading lesson which follows much practice in listening for sounds in words. The teacher pronounces the sound of the initial consonant CVC word to be read (always a nasal or fricative in the early lessons) and writes its letter on the blackboard with a line following it. As she draws out the spoken word for varying periods of time, she shortens or lengthens the line following the letter (s————————, s—, s———). This exercise is repeated with the vowel (a———, a————————, a—). Then both sounds are spoken and the interval between them varied and represented accordingly (s———, a———, s—a———, sa——). The consonant in final position is then added (sa——t) and the word is spoken as a whole (sat). Finally, the word is written without the lines and read aloud. In subsequent lessons, the child is taught to read and write other words by the same procedures.

When he has mastered a word, he writes it in his notebook and perhaps uses it in a written sentence which he also reads aloud. Thus, reading, writing, and spelling exercises are always coordinated, as we have also proposed.

In summary, it must be said that despite the regularity of the Serbo-Croatian orthography, some children — we do not know how many — apparently do encounter difficulties in early reading acquisition. What proportion of these ultimately become fully literate, we also do not know. We have no hard data on either of these questions, though we are told that in the end the children do well and reading disability is not a problem. At all events, cross-national assessments of reading achievement are difficult to evaluate. In this particular case, one does not know how much weight should be given to the regularity of the orthography and how much to the special characteristics of the reading instruction. The answer to this question must await further research.

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Footnotes

1. We are indebted to our colleague, Robert Verbrugge, for a critical reading of the manuscript.
2. A third list, used to study the error pattern in relation to the orthographic complexity of the vowels, was presented at the same time. Those results will be described in detail in a later paper.
3. Ideally, it would have been desirable to provide both the consonant and vowel controls within one list. Contingencies relating to reading and vocabulary levels made this impossible to achieve.
4. Since Serbo-Croatian has two distinct alphabets for the same language, but with various overlaps in letter shapes and their correspondence, questions arise about how these ambiguous letter shapes are interpreted and where in the processing sequence the assignment to one alphabet or the other is made. Michael Turvey of the Haskins Laboratories in collaboration with George Lukatela of the Department of Electrical Engineering at Belgrade University have begun a series of cross-language studies to investigate these interesting questions (Turvey, personal communication).
5. We are grateful to Djordje Kostić, director of the Institute of Experimental Phonetics and Speech Pathology, for providing us with illuminating insights into the Serbo-Croatian language. Special thanks are due to Spasenija Vladisavljević of the Institute

for arranging the school visits and serving as interpreter, guide, and informant throughout our discussions with teachers and school administrators. We are also particularly indebted to Ljubica Taipi, director of Branko Radicevic school in Novi Beograd, for her generous cooperation in permitting us to talk freely with her staff, and to Ljubica Budimirovic, vice-director, for her informative review of their educational programs. Numerous staff members there and in other schools in Belgrade also deserve grateful acknowledgement, but space does not permit mentioning them all by name.

OPEN DISCUSSION OF LIBERMAN PRESENTATION

E. SMITH: My question relates to the earlier part of your talk, where you cite evidence that speech coding goes on even in skilled adult reading. You cited as evidence some of the short-term memory literature that shows acoustic coding. I am concerned about trying to generalize from those studies to actual reading. In those short-term memory studies, the only function that the subject is supposed to perform is maintain the material. Very rarely, in any of those studies, is the subject encouraged to get semantic knowledge out of his lexicon, to find out things about the words, but that's exactly the function that short-term memory must serve in reading. So there are major differences between the functions being served in the short-term memory studies and the role of short-term memory you intend in a theory of reading. Furthermore, in recent studies of short-term memory, when people are encouraged to try to get some lexical knowledge out of the words that they have to hold on to, there is less evidence for acoustic coding and more evidence for semantic coding.

LIBERMAN: There is no question about the need for semantic coding at some point in the process. However, before you can extract the meaning of a phrase or sentence, whether spoken or written, you have to hold the words in some form while you are extracting the meaning. The meaning of the longer segments cannot be extracted from the words taken individually. The words have to be held in some form while you extract the meaning of the whole phrase or sentence. I am simply suggesting that the phonetic representation is best suited for that holding operation.

E. SMITH: Okay, but my point is: If you are holding it just to hold it, then

hold it phonetically.

LIBERMAN: That's right. That's all I am talking about.

E. SMITH: I don't think you are holding it just to hold it in reading. You are holding it to get some knowledge out of it, and in that case I don't think the phonetic form is necessarily optimal.

GREGG: What other form is there?

E. SMITH: I would say that you use the phonetic or visual form to get to the "meaning form." Also, you need short-term memory to combine meanings, to do some kind of parsing and semantic composition.

GREGG: It is very indefinite thing that is being held. It could be lots of different things.

E. SMITH: Yes, it would depend on what we use to represent meaning.

WHITE: Does this need to be adjudicated? There is an abundance of short-term memories to choose from. If we were to use one short-term memory, there would be about 23 left over.

E. SMITH: We are only interested in the ones involved in the reading process.

WHITE: Yes, it is not necessary to assume a role for the short-term memory system. In fact, I think it is very unlikely.

E. SMITH: The point is that I am interested in the system that holds information in reading, while we operate on it and gain semantic knowledge. And I am not sure I would agree that there may be different short-term memories involved.

WHITE: I am not sure how you resolve that.

FLETCHER: Aren't we merely talking about an enabling skill, which, in the case of proficient readers, facilitates the transfer of orthography to meaning somehow. The purpose of the skill is not to facilitate recognition of spelling-to-sound correspondence, is it? I am talking about articulation as an enabling skill. You might well want to get students to the point where they can store into short-term memory some sort of acoustic representation. That might in fact be a necessary first step.

E. SMITH: Yes, I would agree.

LIBERMAN: Yes, I call it a phonetic representation.

FLETCHER: We, too, were very influenced by the speech literature. One idea that had a big effect on most of the work we did at Stanford was that of analysis by synthesis, in which reading--all perception, in fact--is seem as some sort of constructive process. There needs to be some sort of synthesis going on, as the visual cues are coming in. Do you have any speculations about encouraging the sort of synthesis that must be carried on in proficient reading, as opposed to the kind of an analysis needed in these early stages? For instance, do we indeed need some sort of synthesis?

LIBERMAN: My point is that we must get children properly initiated into the alphabetic system at the start of reading instruction. Initial teaching must direct the child's attention to the speech units that the alphabet most directly represents, that is, phoneme-sized segments. If it fails to do this, we seriously mislead the child into believing that the writing system is something other than what it is. For example, he may be wrongly led to conclude that it is an ideographic system. I speak as someone who deals with the casualties of the reading-for-meaning type of approach. Each succeeding year sees a larger proportion of children being diagnosed as "learning disabled." This is simply misdiagnosis on a colossal scale. Most of these educational failures should be considered cases of "teaching disability." I believe that teaching of reading that initiates the child into the nature and purposes of an alphabet would sharply decrease the need for remedial specialists because there would remain only a small residual group of children who require special assistance.

FLETCHER: That certainly reflects my orientation.

I'd like to return to the synthesis business, the business of bringing in reading as some sort of relationship between meaning and orthography [in the Stanford curriculum]. We stopped, we didn't go beyond the simple business of analysis.

LIBERMAN: We need to be clear about the relationship between understanding what we hear and understanding what we read. Ordinarily we do not expect a child to grasp meanings from text that could not be grasped in speech. It is not the job of reading research to produce a theory of language comprehension. If a child cannot grasp from text meanings that he can readily grasp from speech only because he cannot read fluently enough, it is missing the point to say that he

has a comprehension difficulty. Of course, we also use reading as a vehicle to increase the child's comprehension and awareness of language. We seek to develop abilities to paraphrase, to summarize, and to expand the vocabulary by means of reading. Therefore, the lessons ought to be interrelated so that the child understands that they are all part of the same process and not a series of unrelated special skills departmentalized as phonics, spelling, vocabulary, etc.

WHITE: I was struck by the fact that the Elkonin method you described and the method you diagrammed were both very close approximations to a writing method. And I was struck by the agreement between you and Carol Chomsky. I noted just slight differences. You were a little concerned that children worked with conventional sound-letter correspondences. But it seems to me there is more agreement than disagreement between the two lessons.

LIBERMAN: In the later stages of the Elkonin procedure the child is, in effect, learning to spell the words that he hears. However, in the initial stages it is not a writing method. The first purpose of the Elkonin procedure is to acquaint the child with the sound structure of the spoken language before the written characters are introduced. The invented spellings procedure may be a different way of getting at the same understanding. However, the data we have would suggest that children who find phoneme segmentation difficult might also have difficulty with invented spellings. An approach like Elkonin's might therefore be more appropriate for them, as well as avoiding the risk of encouraging the development of an idiosyncratic spelling system that would have to be discarded later.

CLAY: I always find it difficult when people get into polarities. I don't have

any problem with having an instruction scheme in which comprehension is central, and doing everything that you have said. Do you have any comment on that?

LIBERMAN: Of course, children want to read for comprehension, and methods of teaching should exploit this wherever possible. That is why we try to coordinate reading, writing and spelling rather than presenting them as unrelated skills. However, emphasizing comprehension by means of questioning about the content of what is read can be done in such a way that it kills motivation and interest. We should surely avoid questioning the child more closely than the content justifies, because to do so is to incur the risk that he will conclude that reading is tedious and unrewarding.

In contrast, grasp of how the alphabet works can be powerfully reinforcing to a child because it enables him to do so many new things. Children are excited to find that they can decode a new word, a word that they haven't seen in print before. On the other hand, rote methods of teaching word recognition ultimately destroy motivation; it is disappointing to a child to discover that he can read only his basal reader, that when he tries to read something else, as he surely will, he finds it opaque.

CLAY: But as soon as they have a message, which they want to put down on paper, they are aiming at meaning, and they are dealing in letter and sound word transferral.

LIBERMAN: I don't see that there is any problem with that.

CLAY: Then I'd say they are working with meaning, and they are working with analysis at the same time.

LIBERMAN: There is no question about that. They are translating the phonetic representation into meaning as they go along.

ROSNER: I take issue with the comfortable comparison between the invented spelling introduction to reading and the Elkonin method of sensitizing kids to the phonological attributes of language. Elkonin's is a very precise approach. It imposes the phoneme-grapheme concept on the child. It says to him: "child, whether you see the wisdom of it or not, there are a set number of sounds in the words of this language, and we are going to make you exhibit your understanding of that through counters, so that we can introduce you to reading. You will deal with this arbitrary kind of system as though it were completely logical; you will accept the arbitrariness of the system."

The inference I drew from the Chomsky presentation, on the other hand, was that the kids derived something beneficial from discovering an explanation of the mysteries of reading through inventing and applying spelling, through their own analysis system. My hunch is that the children who do it very well are the children who are going to learn how to read very early and very easily. In other words, the concepts of reading are already established to some extent for such kids. But that is speculation.

CHOMSKY: I have some trouble also with the parallel, for slightly different reasons. I think that the writing does permit you to perceive more than your inferences permit. My concern with the parallel is that you say you don't want to do the children a disservice by not letting them in on the alphabetic secret, but I think my reaction to what you said is that you are doing them a disservice in the opposite direction. By leading them to believe that there is a real correspondence between the letters and sounds, and that this letter is pronounced

this way, and that that's the basis of breaking the code, you are doing them a disservice. Of course, then you say they can go on after that, and they can do what they like.

I think that if, from the beginning, there isn't such a strong expectation that the way it's written tells you how to pronounce it, you have a much more accurate picture of the real world. Assuming that the letters give you some clue about how to pronounce them--without forgetting that the pronunciation is not in the letters--allows that understanding from the start.

And I think you are saying that, for a little while you make believe the pronunciation is in the letters, and then you learn that it isn't. And I guess I don't really think it is important even to start with that.

F. SMITH: I just wanted to elaborate on one point, which, in fact, has been very well made by Marie and also by Carol. I don't really know who Isabelle is opposing, although she seems to be opposing someone or some group very vigorously, but I don't know of anyone who would willfully conceal from the child the fact that the spelling system in our language has something to do with speech. What I think is important is to help a child make sense of this relationship between written language and speech, and to come to grips with the complexity of this relationship. It's obviously not as simple as: h-a-m spells ham.

I don't know about the casualties that Isabelle meets from classrooms where the alphabetic principle is concealed, but I am aware of casualties that occur in the high school, where it seems to me kids have become victims of precisely this kind of instruction. They think that comprehension is something that will take care of itself, if only they try to produce some kind of phonemic representation

of the words. This is an extremely complex matter, and I think we have to recognize that there are no simplistic solutions.

GLASER: I think both are true; there are regular correspondences and irregular correspondences, and you have to learn that sometimes there is a regular rule and sometimes there are no rules, or there are irregular rules. It seems to me that maybe they are taught in different ways. With a regular rule, you can almost say, "This is the rule." The ones that have funny correspondences have to be discovered by induction from instances. You have to be problemistic, and you have to learn what the correspondences are. It seems to me that the child needs to learn two classes of rules. I think this is better than assuming that you are unfair to teach one way at the beginning, and one at the end.

LIBERMAN: I think that the major discrepancies between the orthographic and spoken representations are in the vowels. The consonant correspondences are relatively straightforward; there are very few irregularities that have to be learned and children pick up those few differences very quickly. It is the vowel orthography that appears to cause the most difficulty.

The complexity of vowel spellings poses less of a problem than one might suppose for the child who understands the concept of phonemic segmentation. If the child is reading a word, and gets the vowel color slightly wrong, he can often correct it in context. Aside from this, I think that the vowel orthography can largely be taught from rules. There are exceptions, of course. A word like "through" is one. But I think that words like this represent a very small percentage of the words that a child has to deal with in the beginning stages. In our experience, it suffices to teach the child the most common vowel spellings and to encourage him to rely on context.

Frank Smith talked about comprehension problems in children of high school level. The problem that we have encountered is not one of comprehension per se, but of failing to decode beyond the first or second grade level. We find a great number of these children today in Connecticut high schools, and I am sure that our situation is not unique. They read, in essence, by rote, having memorized words. When they see a picture of a man with a pipe and a briefcase and see a text below the picture that has the word father, these children assume, from the context, that this must have to do with the father person, so they read the text as "daddy." I call such unfortunate children nonreaders. Moreover, I am convinced that any child who was initiated into reading via the alphabet-oriented approach I have sketched, would just not make such an error.

DANKS: I noticed what I think was a difference between Chomsky and Liberman, and I wonder if it really is. If so, perhaps it is symptomatic of some underlying differences. Liberman mentioned that fricatives and nasals should be taught early, because of articulation problems.

LIBERMAN: In these particular exercises, because of the problems arising from co-articulation of stop consonants.

DANKS: Right; yet, in Chomsky's paper, it was mentioned that nasals are precisely the ones that are left out of words, the ones that the children aren't picking up.

LIBERMAN: In the medial position. They have no problem with nasals in the initial and final positions. In the medial position, the children attribute the nasalization to the vowel.

DANKS: So the distinction lies in the nasalization of the vowel. In "ham," the child would pronounce the "m."

CHOMSKY: The m is there.

LIBERMAN: Right.

DANKS: But nasalization of the vowel might be missed.

CHOMSKY: In the word can the n is there, but in the word can't, it isn't.

FELSENTHAL: Back to something that was said a little bit earlier: One of the problems with an instructional system which depends on teacher knowledge is that we have to rely on the teacher to make the right decision in terms of when the child is ready to go on. Many teachers don't have this information, so they hold children back. For example, a child in first grade was reading in a series using the linguistics approach. He was taught a rigid phonetic patterning, despite the fact that he was already reading and writing. When he came to the h-o-p combination, I happened to say, "Now, you can read Hop on Top," and he said, "No, we haven't had on." Maybe some children need to follow rigid sequencing, but the teacher must know when to move out of that.

LIBERMAN: I think teachers should be given a theoretical foundation first, a rationale for why they might proceed in certain ways and not in others. I find that when you give teachers that foundation, they can adapt it to meet their practical everyday needs. Teachers are much brighter than we give them credit for.

The second point I should like to make is that in the teaching procedures we recommend, we would also include the teaching of some sight words--for example, of, are, the, etc., words that can't be read phonetically. One or two a day might be taught by a paired associate method as they are required for the simple sentences the children are reading and writing.

CAZDEN: Coming out of a totally different subject, reading in Spanish, I was really struck, Isabelle, by the fact that the system your two Connecticut teachers devised is what I have seen done in Spanish speaking countries.

LIBERMAN: Yes, using a syllabary form is common practice in reading instruction there.

CAZDEN: In fact, we heard the first graders in Buenos Aires reading ma me mi mo mu, la le li lo lu.

LIBERMAN: Teachers in Colombia also report that they are using a syllabary system.

CAZDEN: The payoff is so much greater in Spanish, where there are words of two or three syllables that can be recombined into new words. These children take dictation beautifully.

A personal anecdote: Last year when I was teaching in San Diego, I got two children direct from Mexico. They knew no English at all, and one of them, the second grader, was a fascinating boy who evidently had such a strong sense of the alphabetic principle of reading, that knowing virtually no English, he would come and join in the English reading groups and pronounce all the words on the list.

Now, he had a Spanish accent, and he didn't know the meaning of the words, but he could pronounce the words, virtually all of them, and, of course, the English-speaking children sat there with big eyes, wondering how he managed to do it.

END SESSION